Quarterly Progress Report:
Project Number and Title: 1.8: Enhancing Intelligent Compaction with Passive Wireless Sensors
Research Area: Thrust # 1, Monitoring and Assessment for Enhanced Life
PI: *Ehsan Ghazanfari, The University of Vermont*
Co-PI(s): *Hamid Ossareh, The University of Vermont*
Reporting Period: *1/4/2021 to 6/30/2021*
Submission Date: *6/30/2021*

Overview:

During the past quarter, we continued to analyze the intelligent compaction (IC), pavement quality indicators, and nuclear gauge density data that we collected from field tests in Route 117 (Vermont) reclaimed asphalt pavement project as well as the data collected from another reclaimed stabilized base project in Vermont. The reliability of IC measurement values (ICMVs) and utilization of ICMVs as a function of vibration amplitude and frequency in the control system to optimize the compaction process and minimize the spatial variability of the ICMVs were investigated. Calibration and preliminary testing of the pressure sensor was conducted in the past quarter and exploring viable options for the design/ruggedization of the sensor as well as integration options were continued. The performed work in previous months helps us move closer toward the next steps of the project and to improve the IC performance and facilitate the process of geomaterial compaction and pavement performance monitoring.

Table 1: Task Progress

Task Number	Start Date	End Date	% Complete
Task 1: IC in sub-base/asphalt	07/01/2018	08/30/2020	90%
Task 2: Passive sensor	06/01/2019	09/30/2021	75%
Task 3: Integration options/performance eval.	09/01/2020	12/31/2021	35%
Overall Project:	*07/01/2019*	*12/31/2021*	75%

Table 2: Budget Progress

Project Budget	Spend – Project to Date	% Project to Date*
$254,732	$200,197	76.16%

Table 3: Presentations at Conferences, Workshops, Seminars, and Other Events

Title	Event	Type	Location	Date(s)
Presentation title	Name of event (i.e. TIDC 1st Annual Conference)	i.e. Conference, Symposium, Seminar,		
Geo-statistical Evaluation of the Intelligent Compaction Performance in a Reclaimed Base Project	TIDC Showcase Presentation	Seminar	Virtual	6/23/2021
Geo-statistical Evaluation of the Intelligent Compaction Performance in a Reclaimed Base Project	4th International Conference on Transportation Geotechnics	Conference	Virtual	5/24 to 27/2021

Table 4: Publications and Submitted Papers and Reports

Type	Title	Citation	Date	Status

The revised version of the submitted conference paper (4th International Conference on Transportation Geotechnics), reported in previous quarterly report, is published.
The following paper was submitted for publication in the Journal of "Automation in Construction". Foroutan, M., Ghazanfari, A., Ossareh, H., Ghazanfari, E. Intelligent Compaction: Evaluation of Compaction's Consistency and Uniformity. *Automation in Construction.*

Participants and Collaborators:

Table 5: Active Principal Investigators, faculty, administrators, and Management Team Members

Individual Name	Email Address	Department	Role in Research
Ehsan Ghazanfari	Ehsan.ghazanfari@uvm.edu	Civil & Environmental Engineering	Principal Investigator
Hamid Ossareh	Hamid.Ossareh@uvm.edu	Electrical and Biomedical Engineering	Co-Principal Investigator

Table 6: Student Participants during the reporting period

Student Name	Email Address	Class	Major	Role in research
Maziar Foroutan		Ph.D.	Civil & Environmental Engineering	Graduate Research Assistant
Ahmad Ghazanfari		M.S.	Electrical and Biomedical Engineering	Graduate Research Assistant

Table 7: Student Graduates

Student Name	Role in Research	Degree	Graduation Date
None			

Table 8: Research Project Collaborators during the reporting period

Organization	Location	Contribution to the Project				
		Financial Support	In-Kind Support	Facilities	Collaborative Research	Personnel Exchanges
None						

Table 9: Other Collaborators

Collaborator Name and Title	Contact Information	Organization and Department	Contribution to Research

Name: Callie Ewald

Title: Geotechnical Engineering Manager
Organization: Vermont Agency of Transportation
Location (City & State): Berlin, Vermont
Email Address: callie.ewald@vermont.gov

Changes:
None.

Planned Activities:
(i) analysis of the collected data from IC field tests aiming at IC performance improvement
(ii) continue sensor testing and exploring integration of the sensor in IC compaction